Numerical Example

$V_{CC} = V_{EE} = 10\ V$ Transistors are matched

$R_C = R_E = 4.7\ k\Omega$

$V_{BE} = 0.7V$

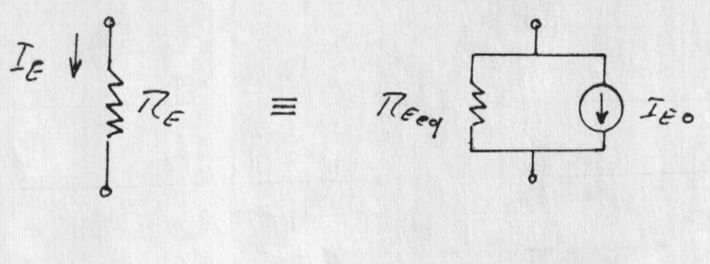
Case A	Case B	Case C
$V_{CM} = 0\ V$	$V_{CM} = -2\ V$	$V_{CM} = +2\ V$
$I_{C1} = I_{C2} \cong 1mA$	$I_{C1} = I_{C2} \cong 0.78mA$	$I_{C1} = I_{C2} \cong 1.2mA$
$V_{CE1} = V_{CE2} \cong 6V$	$V_{CE1} = V_{CE2} \cong 9V$	$V_{CE1} = V_{CE2} \cong 3V$
$h_{ib1} = h_{ib2} \cong 30\Omega$	$h_{ib1} = h_{ib2} \cong 38\Omega$	$h_{ib1} = h_{ib2} \cong 25\Omega$

Conclusion:

Operating point and thus ac performance of the differential amplifier depends on the applied common mode voltage V_{CM}!

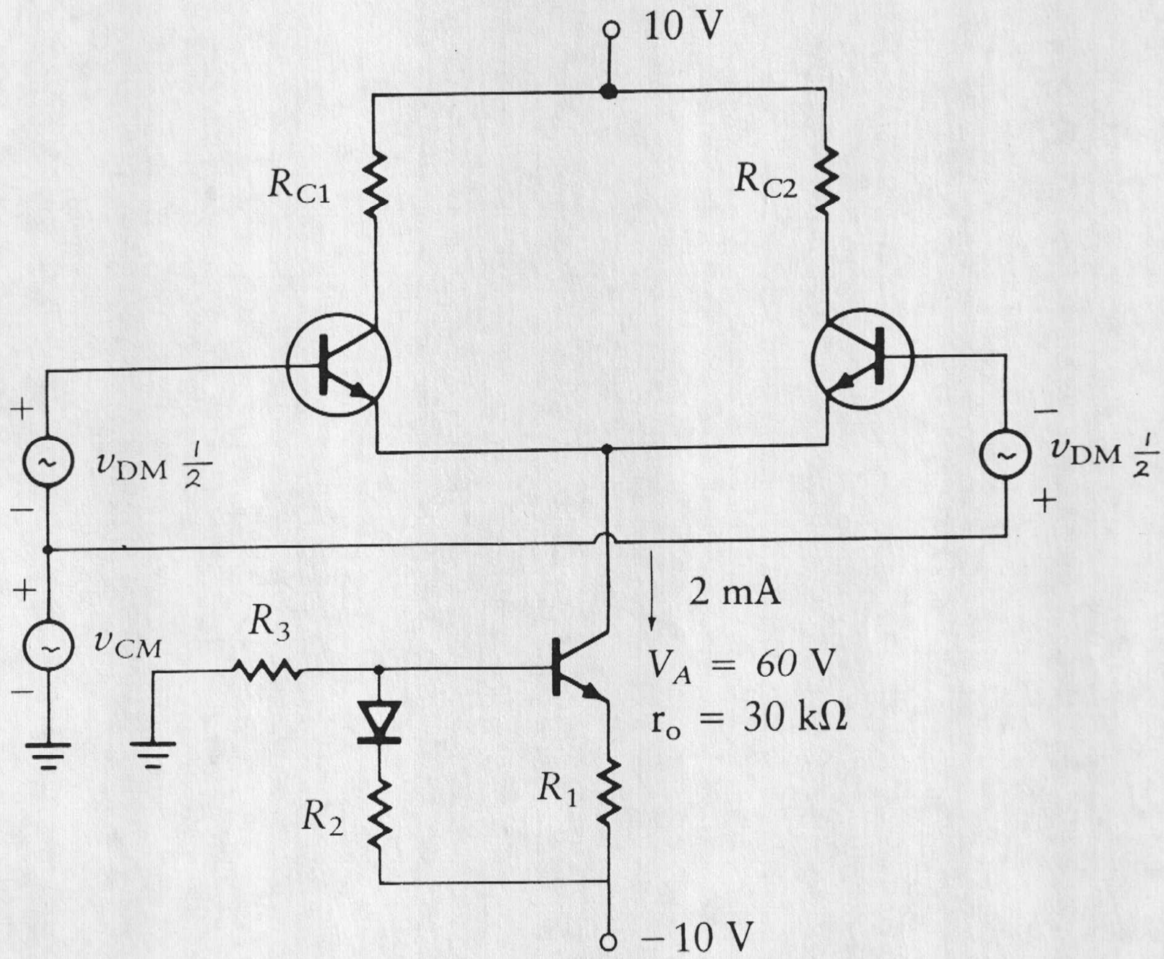
Solution for this problem:

Replace the emitter resistance by a current source! The bias current is then no longer a function of the applied common mode voltage V_{CM} but depends entirely on the current source circuitry.



Typically: $R_{Eeq} \gg R_E$

Differential Amplifier with Current Source Biasing



Equivalent Emitter Resistance of Current Source

$$\left| R_{Eeq} \cong \frac{1}{h_{oe}}\left(1 + \frac{R_1}{\left[\frac{R_1 + R_2}{\beta} + h_{ib}\right]}\right) \right| \quad \text{where } \frac{1}{h_{oe}} \cong \frac{V_A}{I_E}$$

$$h_{ib} \cong \frac{V_T}{I_E}$$